

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ BLACK BORDERS
- ☐ IMAGE CUT OFF AT TOP, BOTTOM OR SIDES
- ☐ FADED TEXT OR DRAWING
- ☐ BLURRED OR ILLEGIBLE TEXT OR DRAWING
- ☐ SKEWED/SLANTED IMAGES
- ☐ COLOR OR BLACK AND WHITE PHOTOGRAPHS
- ☐ GRAY SCALE DOCUMENTS
- ☐ LINES OR MARKS ON ORIGINAL DOCUMENT
- ☐ REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY
- ☐ OTHER: _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.



EUROPEAN PATENT APPLICATION

Application number: 90200594.1

Int. Cl.⁵: H04L 12/56

Date of filing: 14.03.90

Date of publication of application:
18.09.91 Bulletin 91/38

Designated Contracting States:
AT BE CH DE DK ES FR GB GR IT LI LU NL SE

Applicant: ALCATEL N.V.
Strawinskylaan 341
NL-1077 XX Amsterdam(NL)

CH DE DK ES FR GB GR IT LI LU NL SE AT

Applicant: BELL TELEPHONE
MANUFACTURING COMPANY Naamloze
Vennootschap

Francis Wellesplein 1
B-2018 Antwerp(BE)

BE

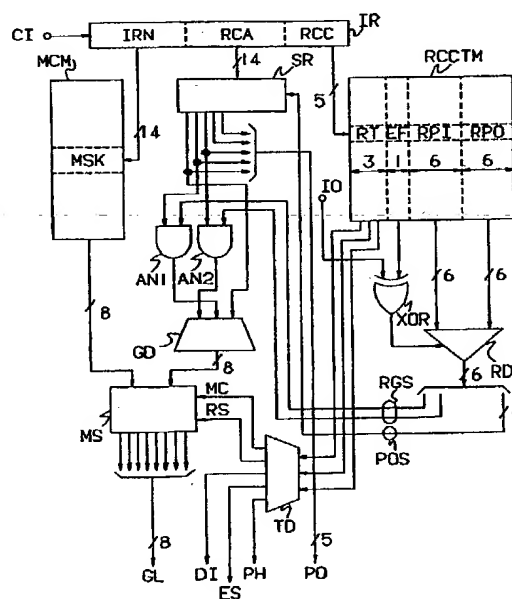
Inventor: Henrion, Michel André Robert
144B Avenue Circulaire 24
B-1180 Brussels(BE)

Representative: Vermeersch, Robert et al
BELL TELEPHONE MANUFACTURING
COMPANY Naamloze Vennootschap Patent
Department Francis Wellesplein 1
B-2018 Antwerpen(BE)

Routing logic means for a communication switching element.

Routing logic means (RL) for a communication switching element (ISE) of a self-routing multi-stage switching network and able to transfer cells or packets of information from any of its inlets (I1-32) to any of its outlets (O1-32). The outlets of the switching element are arranged in routing groups containing one or more of them and of which the identity is derived by the routing logic means from an output-port address (OPA) identifying an output of the switching network and contained in the self-routing-tag (SRT) associated to the cell. This cell is then transferred to one of the outlets belonging to the selected routing group.

The routing logic means (RL) are also able to control the transfer of a cell through the switching element according to the execution of a predetermined routing function selected amongst a plurality of routing functions (RS, DI, MC, BH, IS). This routing function to be executed is selected by the routing logic means according to a routing-control-code (RCC) also contained in the self-routing-tag (SRT) and each value thereof identifies a specific transfer pattern constituted by a predetermined sequence of routing functions to be executed in the switching elements (ISE) through the switching network (SN).



RL FIG. 3

The present invention relates to routing logic means for a communication switching element of a self-routing multi-stage switching network, said switching element being able to transfer information from any one of a plurality of inlets thereof to at least one of a plurality of outlets thereof according to routing data included in a self-routing tag associated to said information.

Such routing logic means are already known in the art, e.g. from the US patent No 4,550,397. Therein, they are associated to binary switching elements, i.e. having two inlets and two outlets, forming part of a multi-stage switching network which has a distribution part and a routing part. These known routing logic means can allow the transfer of the information to any of the two outlets or to only one of these outlets in function of the routing data. The first case of transfer is executed when the switching element belongs to the distribution part of the switching network, whilst the case is executed when this switching element belongs to the routing part of this switching network. In this first case a flip-flop is used to alternately indicate the one of the two outlets to be used, whilst in the second case this flip-flop is not used. This means that the known routing logic means are only able to transfer the information in two possible ways, the selection among them is governed by the use or not use of a flip-flop, i.e. according to the fact that the switching element belongs to the distribution part or to the routing part of the network respectively.

An object of the present invention is to provide routing logic means of the above type, but which can be associated to switching elements of larger size, i.e. with a larger number of inlets and/or outlets. With such switching elements of larger size, the routing logic means should be able to perform routing in such a way as to transfer the information through the switching network over a multiplicity of possible paths (instead of a single deterministic path) in order to increase both performance and reliability of information transfer through that switching network.

According to the invention this object is achieved due to the fact that said switching element is provided with at least three of said outlets, that in each of said switching element said outlets are arranged in at least one routing group, each of said routing groups including from one to all of said outlets, that said routing logic means select at least one of said routing groups by deriving the identity thereof from said routing data which contains at least one output-port address of said switching network, and that said information is transferred to one of said outlets belonging to each of said selected routing group.

In this way the switching elements themselves

perform a "multi-path" routing since groups of outlets (routing groups) are selected by the routing logic means instead of individual outlets. Then, one obtains a multi-path self-routing switching network wherein the selection of the group of outlets (routing group) to be used in each switching element is derived from the output-port address in the self-routing tag, thus providing a relatively large range of possible paths to transfer the information. Indeed, since the routing groups are not limited to include either one or all the outlets but may include any number of them, there are much more transfer possibilities than these which are only associated to the fact that the switching element pertains to the distribution or to the routing part of the switching network.

The present invention also relates to routing logic means for a communication switching element of a self-routing multi-stage switching network, said switching element being able to transfer information from any one of a plurality of inlets thereof to at least one of a plurality of outlets thereof according to the execution of a predetermined routing function selected by said routing logic means amongst a plurality of routing functions.

Referring again to the above cited US patent, the routing logic means of the switching elements thereof are only able to execute two different routing functions: a first one in which the transfer of the information to either one of the two outputs is allowed, and a second one in which this choice is not authorized.

Another object of the present invention is to provide routing logic means of the above type, but which allow either one of a relatively more considerable number of routing functions to be selected in a flexible way.

According to the invention this other object is achieved due to the fact that said switching element is provided with at least three of said outlets and that said information is associated to a self-routing tag including a routing-control-code which, in each of said switching elements, is used by said routing logic means to select one of said routing functions to be executed, each value of said routing-control-code identifying a specific transfer pattern constituted by a predetermined sequence of routing functions to be executed by said switching elements through said switching network.

In this way a given routing-control-code value allows the execution of a different routing function in each of the switching elements of the switching network through which the information is transferred. Moreover, the routing function executed is then no more only dependent on the fact that the switching element pertains to the distribution part or to the routing part of the switching network. This

allows thus the choice between a relatively large number of possible routing functions.

The above mentioned and other objects and features of the invention will become more apparent and the invention itself will be best understood by referring to the following description of an embodiment taken in conjunction with the accompanying drawings wherein:

Fig. 1 shows a communication switching element ISE including routing logic means RL according to the invention;

Fig. 2 is a principle connection circuit of a switching element ISE as in Fig. 1 and having bidirectional and reflection capabilities; and

Fig. 3 represents the routing logic means RL of Fig. 1 and Fig. 2 in more detail.

The communication switching element ISE schematically shown in Fig. 1 is for instance of the type disclosed in the non-published PCT application PCT/EP/000942. It can be used to build up various stages of a folded or non-folded multipath self-routing switching network, e.g. of the type disclosed in the co-pending patent application of even date and entitled "RESEAU DE COMMUTATION A TRAJECTS MULTIPLES ET A AUTO-ACHEMINEMENT POUR LA COMMUTATION DE CELLULES A MULTIPLEXAGE TEMPOREL ASYNCHRONES".

When such multipath self-routing switching networks are "asymmetrical", i.e. have one single transfer direction from all inlets to all outlets, all the switching elements thereof, such as ISE shown in Fig. 1, are unidirectional, i.e. perform routing operations in a single direction from a single set of inlets I1/32 to a single set of outlets O1/32.

When such switching networks are "symmetrical", i.e. have both incoming or first transfer direction and outgoing or second transfer direction handled by the same switching elements ISE, and when they are non-folded, each of these switching elements ISE is arranged, as shown in Fig. 2, by splitting its inlets I1/32 in two sets: one for the incoming direction (A), e.g. I1/16, and one for the outgoing direction (B), e.g. I17/32, as well as its outlets O1/32 in two sets: one for the incoming direction (A), e.g. O1/16, and one for outgoing direction (B), e.g. O17/32. In this case, "reflection", i.e. change of internal transfer direction (C, D), can be executed in any switching element stage. This will be explained in more detail later.

When such switching networks are symmetrical and folded, all switching element stages except the middle ("mirror") stage, are handling both incoming (A) and outgoing (B) transfer directions and may also perform a reflection - then called "early" reflection -, whereas the middle ("mirror") stage (which is unidirectional, i.e. without split of the inlets and the outlets in two sets) naturally per-

forms a systematic reflection for cell transfer from incoming to outgoing direction in the switching network.

In more detail and when using switching elements ISE for two internal transfer directions, the inputs or inlets I1 to I32 as well as the outputs or outlets O1 to O32 of these switching element ISE can be arranged as shown in Fig. 2, i.e. they are each grouped in first and second sets I1/16 and I17/32 as well as O1/16 and O17/32 respectively. Internally, the switching element ISE is only able to transfer a cell of information in an unidirectional way, i.e. from left to right as shown in Fig. 1, but externally it allows the transfer of such cells in a bidirectional way, i.e. from left to right or from right to left. More particularly, in case there is no reflection, cells can be transferred from the inlets of the first set I1/16 or those of the second set I17/32 to any of the outlets of the first set O1/16 or of the second set O17/32 according to the first (A) or the second (B) transfer direction respectively, whereas in case of reflection, cells can be transferred from the former inputs to any of the outlets of the second set O17/32 or the first set O1/16 according to the third (C) and the fourth (D) transfer direction respectively.

The inlets of the first set I1/16 can be identified by a direction indicator or bit IO at a particular binary status, e.g. at the logical level 0, whilst those of the second set I17/32 are identified by the opposite binary status, e.g. 1, of this bit IO. The various direction bits IO are for instance provided by flip-flops (not shown) which are associated to respective ones of the inlets I1/32 and whose outputs are coupled to the inputs of a multiplexer (not shown) having as output the direction indicator IO which is applied to a like-named input to the routing logic RL (Fig. 3). This multiplexer is for instance controlled by an input clock signal (not shown) which allows the flip-flop outputs to be successively coupled to the output IO. This clock signal is for instance the same as the one used for successively coupling the inlets I1/32 of the switching element ISE to the input CI (Fig. 3) of the routing logic circuit or means RL as described in the above PCT application.

The above outlets O1/32 of the switching element ISE are also grouped in so-called routing groups, any of the outlets of each of these routing groups allowing access to a requested output transfer direction in the switching network, i.e. towards an output of the switching network which is identified by an output-port-address OPA, contained in an address field also called Routing Control Address RCA of a control header called self-routing tag SRT associated to the cell of information. In the present case and as an example these outlets O1/32 are supposed to be grouped in one

(also called distribution group), two, four or maximum eight routing groups each comprising for instance 32, 16, 8 or 4 outputs respectively. It is to be noted that a same outlet O1/32 may even form part of several routing groups and that it is also possible to have 32 routing groups each comprising only one outlet O1/32.

The switching element ISE is able to switch cells or packets of information on the basis of routing data included in the self-routing tag SRT forming part of the control header of these cells and under the control of the routing logic circuit RL shown in Fig. 3. More particularly, the switching element ISE is able to switch either mono-slot cells of fixed length, each having a header with a self-routing tag SRT, or cells of fixed or variable length called "Multi-Slot-Cells" (MSC) constituted by a series of successive subcells of equal length. In the latter case the first subcell contains the multi-slot cell (MSC) header, i.e. the self-routing tag SRT.

As will be described later, from the analysis of the self routing tag SRT of a cell or of a first subcell and more particularly of a portion of the address field or part thereof, the routing logic circuit RL derives the following routing enable signals which are each indicative of a routing function or operation to be performed:

- a "group-routing" enable signal RS which is activated when a cell transfer from an inlet I1/I32 to a single one of the above routing groups has to be performed. This routing function is to be performed in case of point-to-point transfer and called point-to-point routing;
- a "multicast-routing" enable signal or indicator MC which is activated when a cell transfer from an inlet I1/I32 to a plurality of the above routing groups has to be realized. This routing function is to be executed in case of point-to-multipoint transfer;
- a "distribution" enable signal or indicator DI which is activated when a cell has to be transferred to any of all the 32 outlets in case of ISE used unidirectionally or any of all the 16 outlets of one set of outlets in case of ISE used bidirectionally.

Because any of the 32 or 16 outlets O1 to O32 or O16 may be selected, the use of this distribution indicator DI is preferred to the selection of a single routing group comprising these 32 or 16 outlets although a same result is obtained thereby. This routing function may for instance be used in a distribution part of the above mentioned multi-path self-routing switching network which may typically comprise a first or distribution part followed by a second or routing part;

- a dedicated-routing enable signal or indicator

ES which is activated when a cell transfer has to be performed from an inlet I1/32 to a dedicated outlet (not shown) used for a special control purpose and distinct from the above outlets O1/32. This routing function is called dedicated routing; and

- a "physical-routing" enable signal or indicator PH which is activated when a cell transfer from an input to a predetermined outlet O1/32, also called physical output, has to be performed. This routing function, also called directed routing, causes a so-called physical transfer of the cell to one outlet and may for instance be used for test purposes.

In the example selected for description, the routing logic circuit RL also provides the following output signals:

- a routing group output signal GL which identifies a single routing group or a plurality of routing groups among the maximum of 8 possible routing groups, depending on the enabling signal RS or MC being activated respectively;
- an output identity signal PO which indicates the identity of a selected physical output among the 32 outlets O1 to O32 and is used when the corresponding enabling signal PH is activated.

In the present example, the routing logic circuit RL has inputs CI, IO and outputs GL, DI, ES, PH and PO and includes the following elements which are interconnected as shown in Fig. 3:

- a 33-bit input register IR with input CI and intended to store the self-routing tag SRT of each cell received at an inlet I1/32 of the switching element ISE;
- a routing-control-code-translation memory RCCTM, storing 32 16-bit data words constituted by routing parameters corresponding to different routing operations able to be executed by the switching element ISE for various possible transfer patterns. Each of these data words comprises a 3-bit routing type code RT, a reflection indicator or bit EF, a 6-bit "incoming" routing group field RPI and a 6-bit "outgoing" routing group field RPO, RPI and RPO constituting two sets of routing-mode parameters;
- a multicast-branch-point memory MCM storing a plurality of 8-bit mask words MSK each corresponding to a multi-cast tree and containing the identities of a plurality of routing groups corresponding to the branches of that tree at that switching stage;
- a routing function decoder TD to decode the routing type code RT into the above mentioned enable signals or indicators RS, MC, DI, ES, PH from the RCCTM memory se-

lected by the Routing- Control- Code RCC forming part of the self- routing tag SRT and received in the input register IR;

- a direction selector RD to select either the incoming or outgoing routing group field RPI or RPO, i.e. the first RPI or the second RPO set of routing- mode parameters respectively, from a data word of the memory RCCTM, under the control of the reflection indicator or bit EF and of the direction indicator or bit IO;
- a selector MS having two sets of 8 inputs and a routing group output GL also constituted by a set of 8 output wires each assigned to a distinct one of the 8 possible routing groups. MS allows either one of these two sets of 8 input wires to be connected to the set of 8 output wires. The above mentioned routing group output signal GL is generated on this like- named output;
- a 14- bit shift register SR having a multiple output PO constituted by 5 wires. In case the routing function "physical- routing" (PH) is selected, these 5 wires carry corresponding bits of the binary address or identity of the physical output O1/32 to be selected. This means that the above mentioned output identity signal PO is provided on this like named output. In case the routing function "group- routing" RS is selected, a variable number of bits, from 1 to 3 in this example with 8 routing groups maximum, gives the routing group identity to be used for routing;
- a group number decoder GD;
- an exclusive- OR gate XOR; and
- two AND gates AN1 and AN2.

The above routing logic circuit RL operates as follows.

When an information cell with a header containing a self routing tag SRT is applied to one of the inlets I1/32 of the switching element ISE, a flip-flop associated to this inlet indicates to which set of inlets I1/16 or I17/32 this inlet belongs. Via multiplexers (not shown) the SRT of the incoming cell is applied to the input CI of the input register IR, whilst the condition of the flip- flop is applied to the input IO. of the circuit RL. Subsequently, the self- routing tag SRT is entered in the input register IR. SRT includes a 14- bit Internal Reference Number IRN also called multicast- tree- reference number , the above 14- bit Routing Control Address RCA and the above 5- bit routing- control- code RCC. Afterwards the RCA is entered in the shift register SR.

The internal reference number IRN here is a number used within the switching network to identify the point- to- multipoint communication to which a cell pertains. It is obtained at the entry of the switching network by translation of an external

protocol label identifying the communication.

As already mentioned, the routing control address RCA is the address field or part of the self- routing tag SRT. It generally contains the output- port- address OPA which is the destination address in the switching network, i.e. the identity of the switching network output(s) to which the cell has to be transferred (routed) through this switching network. Because the switching element ISE under consideration belongs to a particular stage of the switching network, it is clear that only a portion of this output- port- address OPA is required by the switching element ISE to perform point- to- point transfer of an incoming cell to a given routing group comprising one or more of its outlets O1/32.

It is to be noted that the address part RCA of the self- routing tag SRT may also contain the identity of the above physical output or that of the dedicated outlet. It is also possible that the latter identities are contained in an other part of SRT leaving RCA free for containing the OPA.

The routing- control- code RCC is indicative of a particular sequence of routing functions to be executed by the successive switching elements ISE of the switching network through which a cell is transferred. Such a sequence of routing functions is called a transfer pattern. This means that a same routing- control- code RCC may lead to the execution of different routing functions in different switching elements ISE. In other words, the routing control code RCC is indirectly indicative of the routing function to be executed in each ISE for a given transfer pattern. The routing parameters of this routing function are obtained by using the routing- control- code RCC as a pointer to select a data word in the routing- control- code- translation memory RCCTM. As described above such a data word comprises RT, EF, RPI and RPO and its contents is thus dependent of the switching network stage to which the switching element ISE pertains.

The routing type code RT is decoded in the routing type decoder TD which accordingly activates one of its enable signals RS, MC, ES, DI or PH indicative for the above routing functions "group- routing", "multicast- routing", "dedicated- routing", "distribution" or "physical- routing" respectively.

The reflection indicator or bit EF is at the logical level 1 when the transfer direction has to be changed, i.e. that the third (C) or the fourth (D) transfer direction has to be used instead of the "normal" first (A) or second (B) transfer direction. The cell is then said to be reflected and is transferred either from an inlet of the first set I1/16 to an outlet of the second set O17/32, i.e. according to the third transfer direction (C), or from an inlet of the second set I17/32 to an outlet of the first set

O1/16, i.e. according to the fourth transfer direction (D). In the other case, i.e. when EF is at the logical level 0, no reflection has to be performed and the first (A) or the second (B) transfer directions are used. The reflection indicator EF and the above direction indicator IO are applied to distinct inputs of the gate XOR which provides an output control signal for the direction selector RD. In function of this control signal this selector RD selects either the first set RPI or the second set RPO of the routing- mode parameters from the data word selected by the routing- control- code RCC. Each of the routing- mode parameters RPI and RPO define a portion of the output- port- address OPA contained in that routing control address RCA which is then stored in SR and is to be transcoded for obtaining the identity of, e.g., a single routing group. Each set RPI or RPO is constituted by a 4-bit position indicator POS and a 2- bit size indicator RGS. The position indicator POS indicates the begin position of the first bit of the above portion of the output- port- address OPA which is required by the switching element ISE as identity of the routing group to which the cell has to be transferred whilst the size indicator RGS gives the number of bits to be read in OPA from this being position. In practice, the position indicator POS controls the shift register SR in such a way that OPA is shifted therein over a number of steps (bits) such that the predetermined portion thereof occupies the most left position in this register SR. The size indicator RGS indicates how many bits out of this portion of the OPA have to be used for obtaining the identity of a single routing group by transcoding these bits, the maximum number of bits being 3 in this example. For this reason the 3 left hand outputs (one output per bit) of SR are applied to the group decoder GD directly, via AN1 and via AN2 respectively, AN1 and AN2 being controlled by respective ones of the 2 bits of RGS. The output of GD is an 8- bit word which indicates the identity of a single routing group and is applied to one of the 8- bit inputs of the selector MS. Moreover, each bit of the 8- bit output word of GD corresponds to the identity or address of one routing group, i.e. that only one bit of this word is, e.g., at the logical level 1 whilst the other bits are at the logical level 0. To be noted that depending on the value of RGS the single identity bit belongs to a group of 2, 4 or 8 bits.

Simultaneously with the transcoding of the above portion of the OPA, the 14- bit internal routing number IRN stored in IR is used to select a 8- bit mask word MSK in the memory MCM by pointing to this memory. As already mentioned above this mask word MSK identifies a plurality of routing groups (which relate to the branches of the concerned multicast tree reference number IRN at

that ISE stage), i.e. that more than 1 bit thereof are at the logical level 1. It is applied to the other 8- bit input of the selector MS.

Depending on the enabling signal RS or MC provided by the routing function decoder TD being activated, either the 8- bit word provided by GD or that generated by MCM is supplied to the output GL of the selector MS. In other words, either the identity of a single routing group or the identities of a plurality of routing groups are provided at this output GL.

In case "physical- routing" PH is selected, after the OPA has been shifted in the shift register SR, the 5 most left bits thereof define the binary identity of a physical outlet O1/32. This identity appears on the output PO and is used when also the physical- routing enabling signal PH is activated.

The particular case of selecting any of the 32 outlets O1/32, i.e. the case of distribution, is not considered in detail here as it requires no further treatment in the routing logic RL. However, it corresponds to the activation of the distribution enabling signal DI.

In case the dedicated- routing enabling signal ES is activated this allows the cell to be transferred to a special outlet (not shown) of the switching element ISE.

From the above it follows that the RCC value indicative of a given transfer pattern is translated by using the memory RCCTM and that the information obtained therefrom is used to transcode a portion of the routing control address RCA, whilst the IRN is translated by using the memory MCM.

Also in case a switching element ISE is only used unidirectionally, i.e. for a single transfer direction, the memory RCCTM only records the data words for one routing group field or one set of routing- mode parameters, e.g. RPI. Besides, in such a case, it does not need to store a reflection indicator EF.

It is also to be noted that instead of providing a flip- flop per inlet I1/32 in an ISE used for 2 transfer directions, it would also be possible to provide a bit in the self- routing tag SRT to indicate in which transfer direction, incoming or outgoing, the cell is currently transferred in the switching network. Then, when and if reflection is performed this bit has to be inverted to indicate that the cell will now go in the other transfer direction through the switching network. This possibility is not discussed in detail here.

It is also to be noted that another co-pending patent application of even date and entitled "Communication switching module" discloses a method to fill the routing- control- code- translation memory RCCTM of the switching element ISE with the appropriate routing parameters during the ini-

tialization phase of the switching network.

Finally, it is also to be noted that the above routing parameters may be alternatively included in the self- routing tag SRT associated to the cell of information. This may for instance be realized by reserving 1 bit of SRT for each required routing parameter and for each switching element ISE when the indicator depends on the ISE stage number. Different routing functions can thus be executed by different switching elements ISE. It is also possible to define a reflection or change- of- direction bit in the self- routing tag SRT for indicating in which stage of the switching network, i.e. in which switching element a reflection or change of transfer direction has to be performed.

While the principles of the invention have been described above in connection with specific apparatus and particular numerical figures, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

Claims

1. Routing logic means (RL) for a communication switching element (ISE) of a self- routing multi- stage switching network, said switching element being able to transfer information from any one of a plurality of inlets (I1/32) thereof to at least one of a plurality of outlets (O1/32) thereof according to routing data included in a self- routing tag (SRT) associated to said information,
 - characterized in that said switching element (ISE) is provided with at least three of said outlets (O1/32),
 - in that in each of said switching element (ISE) said outlets (O1/32) are arranged in at least one routing group, each of said routing groups including from one to all of said outlets,
 - in that said routing logic means (RL) select at least one of said routing groups by deriving the identity thereof from said routing data which contains at least one output- port- address (OPA) of said switching network,
 - and in that said information is transferred to one of said outlets (O1/32) belonging to each of said selected routing group.
2. Routing logic means (RL) according to claim 1, characterized in that said self- routing tag (SRT) includes a distribution indicator (DI) specifying at which stage of said switching network the switching element (ISE) thereof may transfer said information to any of its outlets (O1/32) when said distribution indicator is set.
3. Routing logic means (RL) according to claim 1, characterized in that the split- up of said outlets (O1/32) in said routing groups is dependent on the stage of said switching element (ISE) in said switching network, and in that said split- up is specified by first routing- mode parameters predetermined for each of said switching elements (ISE).
4. Routing logic means (RL) according to claim 3, characterized in that said first routing- mode parameters further indicate to said switching element (ISE) when said information may be transferred to one of said routing groups including all said outlets (O1/32).
5. Routing logic means (RL) according to claim 3, characterized in that said first routing- mode parameters allow said routing logic means (RL) to extract said routing group identity from said output- port- address (OPA) by indicating a number of bits (RGS) to be read and their position (POS) in said output- port- address (OPA).
6. Routing logic means (RL) according to claim 1, characterized in that said self- routing tag (SRT) includes a multicast indicator (MC) indicating that said switching element (ISE) has to transfer said information to a plurality of its routing groups when said multicast indicator is set, and in that said self- routing tag (SRT) further includes a multicast- tree- reference- number (IRN) which allows said routing logic means (RL) to address a multicast- branch- point memory (MCM) also included in said switching element (ISE) and containing the identities of a plurality (MSK) of said routing groups for each of said multicast- tree- reference- numbers (IRN).
7. Routing logic means (RL) according to claim 6, characterized in that said multicast indicator (MC) further specifies at which stage of said switching network the switching element (ISE) thereof has to transfer said information to a plurality of its routing groups when said multicast indicator is set.
8. Routing logic means (RL) according to claim 1, characterized in that said self- routing tag (SRT) includes a physical- routing indicator (PH) indicating to said switching element (ISE) that said information has to be transferred to one of said outlets (O1/32) of which the identity is derived by said routing logic means (RL) from at least a portion of said routing data when said physical- routing distribution indica-

tor is set.

9. Routing logic means (RL) according to claim 8, characterized in that said routing logic means (RL) derive said identity of said outlet (O1/32) from said portion of said routing data by means of second routing- mode parameters predetermined for each of said switching elements (ISE) and specifying the position (POS) and the size (RGS) of said portion of said routing data to be used. 5
10. Routing logic means (RL) according to claim 1, characterized in that said self- routing tag (SRT) includes a dedicated- routing indicator (ES) specifying at which stage of said switching network the switching elements (ISE) thereof has to transfer said information to a predetermined dedicated outlet distinct from said outlets (O1/32) when said dedicated- routing indicator (ES) is set. 10
11. Routing logic means (RL) according to claim 3, characterized in that said inlets (I1/32) are grouped in a first (I1/16) and in a second (I17/32) sets of inlets, 25
 - in that said outlets (O1/32) are grouped in a first (O1/16) and in a second (O17/32) sets of outlets,
 - in that said information is transferred from said first set of inlets (I1/16) to said said first set of outlets (O1/16) according to a first transfer direction (A), 30
 - in that said information is transferred from said second set of inlets (I17/32) to said said second set of outlets (O17/32) according to a second transfer direction.(B), 35
 - and in that said routing logic means (RL) use distinct ones of said first routing- mode parameters for said first (A) and for said second (B) transfer direction respectively in order to perform different routing functions according to selected output direction. 40
12. Routing logic means (RL) according to claim 11, characterized in that said information is transferred from said first set of inlets (I1/16) to said said second set of outlets (O17/32) according to a third transfer direction (C), 45
 - in that said information is transferred from said second set of inlets (I17/32) to said said first set of outlets (O1/16) according to a fourth transfer direction (D), 50
 - and in that said self- routing tag (SRT) includes a reflection indicator (EF) specifying, when said reflection indicator (EF) is set, at which stage of said switching network the switching element (ISE) thereof has to transfer 55

said information according to said third (C) or to said fourth (D) transfer direction.

13. Routing logic means (RL) for a communication switching element (ISE) of a self- routing multi-stage switching network, said switching element being able to transfer information from any one of a plurality of inlets (I1/32) thereof to at least one of a plurality of outlets (O1/32) thereof according to the execution of a predetermined routing function selected by said routing logic means (RL) amongst a plurality of routing functions (RS, DI, MC, PH, ES),

characterized in that said switching element (ISE) is provided with at least three of said outlets (O1/32) and in that said information is associated to a self- routing tag (SRT) including a routing- control- code (RCC) which, in each of said switching elements (ISE), is used by said routing logic means (RL) to select one of said routing functions (RS, DI, MC, PH, ES) to be executed, each value of said routing- control- code (RCC) identifying a specific transfer pattern constituted by a predetermined sequence of routing functions to be executed by said switching elements (ISE) through said switching network.

14. Routing logic means (RL) according to claim 13, characterized in that said outlets (O1/32) are arranged in at least one routing group, each of said routing groups including from one to all of said outlets (O1/32),

in that said routing logic means (RL) further select at least one of said routing groups according to said selected routing function,

and in that said information is transferred to one of said outlets (O1/32) belonging to said selected routing group.

15. Routing logic means (RL) according to claim 14, characterized in that different routing group arrangements are defined in various stages of switching elements (ISE) in said switching network,

in that said information is associated to an output- port- address (OPA) of said switching network,

and in that said routing- control- code (RCC) allows said routing logic means (RL) to indicate to its associated switching element (ISE) that a point- to- point routing has to be performed and to select the corresponding routing group identity in said output- port- address (OPA) by means of derived pre- assigned routing- mode parameters (POS, RGS) for the concerned value of said routing- control- code (RCC) in said switching element

(ISE).

16. Routing logic means (RL) according to claim 15, characterized in that said pre- assigned routing- mode parameters (POS, RGS) used to extract said routing group identity from said output- port- address (OPA), include parameters defining in each switching element (ISE) the position (POS) and size (RGS) of a portion of said output- port- address (OPA) which allows to identify the routing group to be selected.

17. Routing logic means (RL) according to claim 16, characterized in that other values of said routing- control- code (RCC) indicate that multicast routing has to be performed, said routing logic means (RL) then use a multicast- tree- reference number (IRN) included in said self- routing tag (SRT) to address a multicast- branch- point memory (MCM) and obtain the identities of the routing groups to which a copy of said information has to be transferred.

18. Routing logic means (RL) according to claim 16 or 17, characterized in that still other values of said routing- control- code (RCC) indicate that said routing logic means (RL) have to perform a physical transfer to one of said outlet (O1/32), the analysis of said routing- control- code (RCC) then provides position (POS) and size (RGS) parameters for physical- routing pointing to an address field in the self- routing tag (SRT).

19. Routing logic means (RL) according to claim 16, 17 or 18, characterized in that still other values of said routing- control- code (RCC) indicate that said routing logic means (RL) have to perform a dedicated routing to a pre- determined dedicated outlet distinct from said outlets (O1/32).

20. Routing logic means (RL) according to claim 16, 17, 18 or 19, characterized in that said inlets (I1/32) are grouped in a first (I1/16) and in a second (I17/32) sets of inlets,

in that said outlets (O1/32) are grouped in a first (O1/16) and in a second (O17/32) sets of outlets,

in that said information is transferred from said first set of inlets (I1/16) to said said first set of outlets (O1/16) according to a first transfer direction (A),

in that said information is transferred from said second set of inlets (I17/32) to said said second set of outlets (O17/32) according to a second transfer direction (B),

and in that said routing- control- code (RCC) is used differently depending on the required one of said transfer direction (A, B) so that distinct routing functions can then be performed for each of said transfer directions (A, B).

21. Routing logic means (RL) according to claim 20, characterized in that different sets of said routing mode parameters (POS, RGS) are used depending on the selected one of said transfer directions (A, B).

22. Routing logic means (RL) according to claim 20, characterized in that said information is transferred from said first set of inlets (I1/16) to said said second set of outlets (O17/32) according to a third transfer direction (C),

in that said information is transferred from said second set of inlets (I17/32) to said said first set of outlets (O1/16) according to a fourth transfer direction (D),

and in that said routing- control- code (RCC) allows to derive a reflection indicator (EF) to control the change of the selected output direction.

23. Routing logic means (RL) according to any claim from 13 to 22, characterized in that said routing- control- code (RCC) is used to address a routing- control- code translation memory (RCCTM) containing for each value of said routing- control- code (RCC) appropriate routing parameters (RT, EF, POS, RGS) to be used by said routing logic means (RL) to identify the appropriate routing group or individual outlet to be selected.

24. Routing logic means (RL) according to claim 23, characterized in that said appropriate routing parameters include said reflection indicator (EF), said routing- mode parameters and the type of routing to be executed.

25. Routing logic means (RL) according to claim 11 or 20, characterized in that said first (A) or said second (B) transfer direction is derived in each switching element (ISE) from the fact that said information is received on an inlet (I1/32) belonging to said first (I1/16) or to said second (I17/32) set of inlets respectively.

26. Routing logic means (RL) according to claim 11 or 20, characterized in that said first (A) or said second (B) transfer direction is explicitly indicated by a direction bit in said self- routing tag (SRT).

27. Routing logic means (RL) according to claim 26 and to claim 12 or 22, characterized in that said change of said transfer direction (A, B, C, D) modifies accordingly the status of said direction bit in said self-routing tag (SRT). 5
28. Routing logic means (RL) according to claim 15 16, 17, 20, 21, 22 or 23, characterized in that each of said routing groups only comprises one of said outlets (O1/32). 10
29. Routing logic means (RL) according to any of the previous claims, characterized in that said information is constituted by information cells or packets. 15
30. Routing logic means (RL) according to claim 29, characterized in that the data of said self-routing tag (SRT) is contained in a control header of said cells or packets of information. 20

25

30

35

40

45

50

55

10

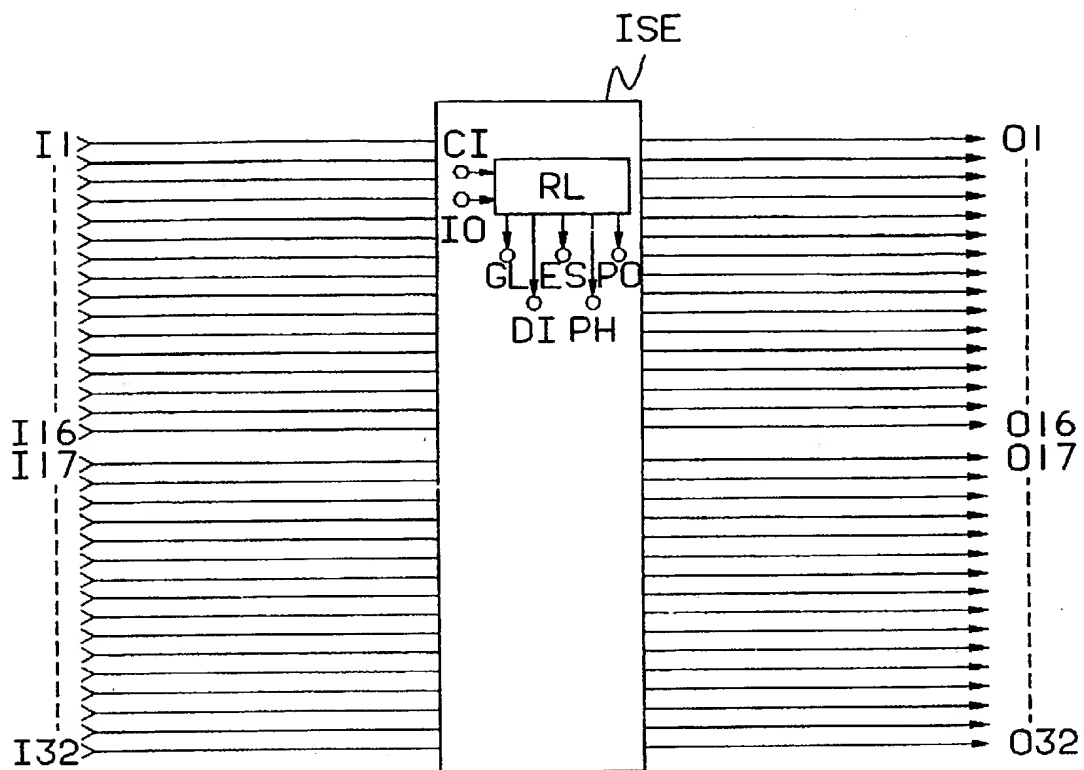


FIG. 1

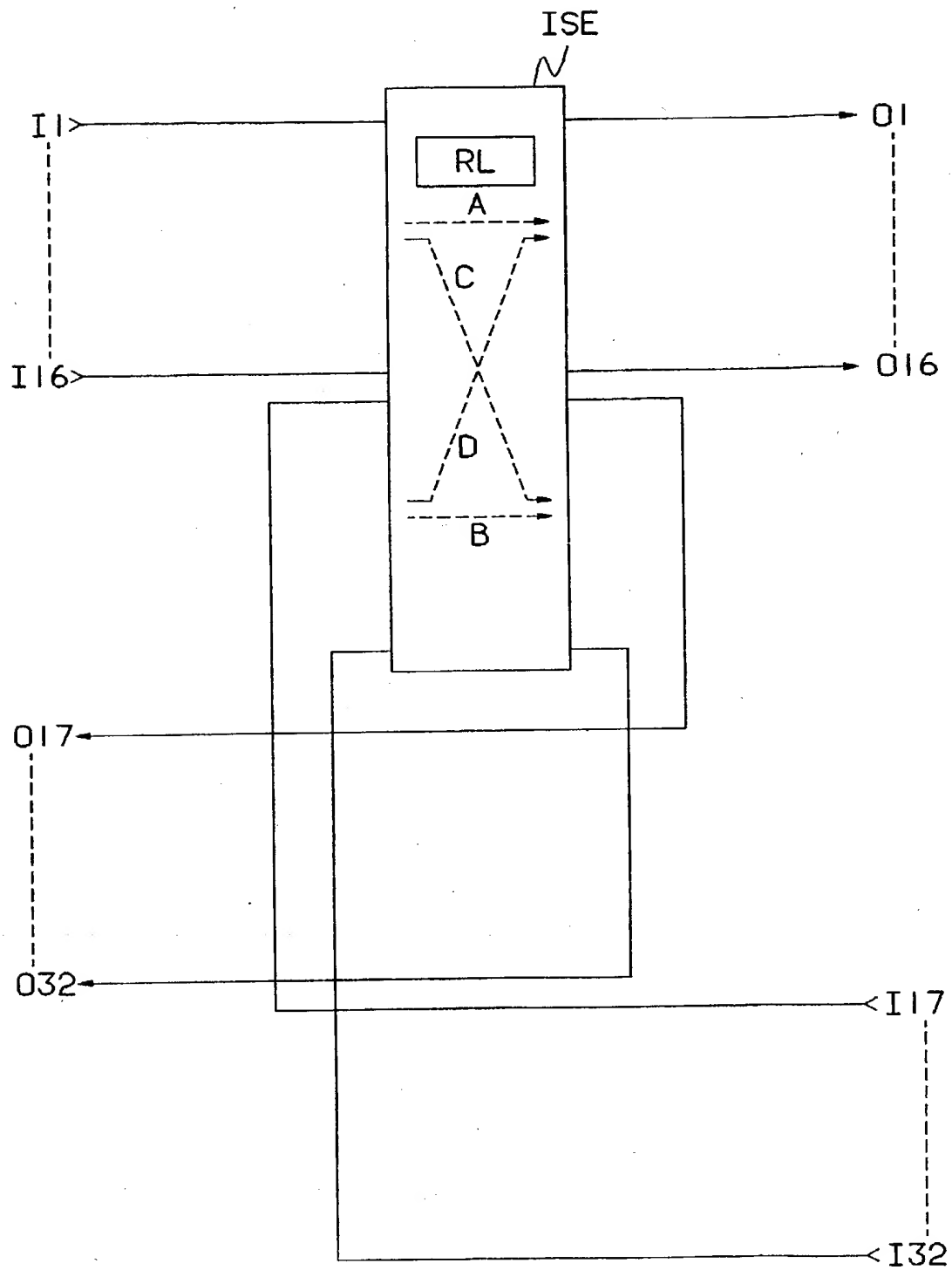
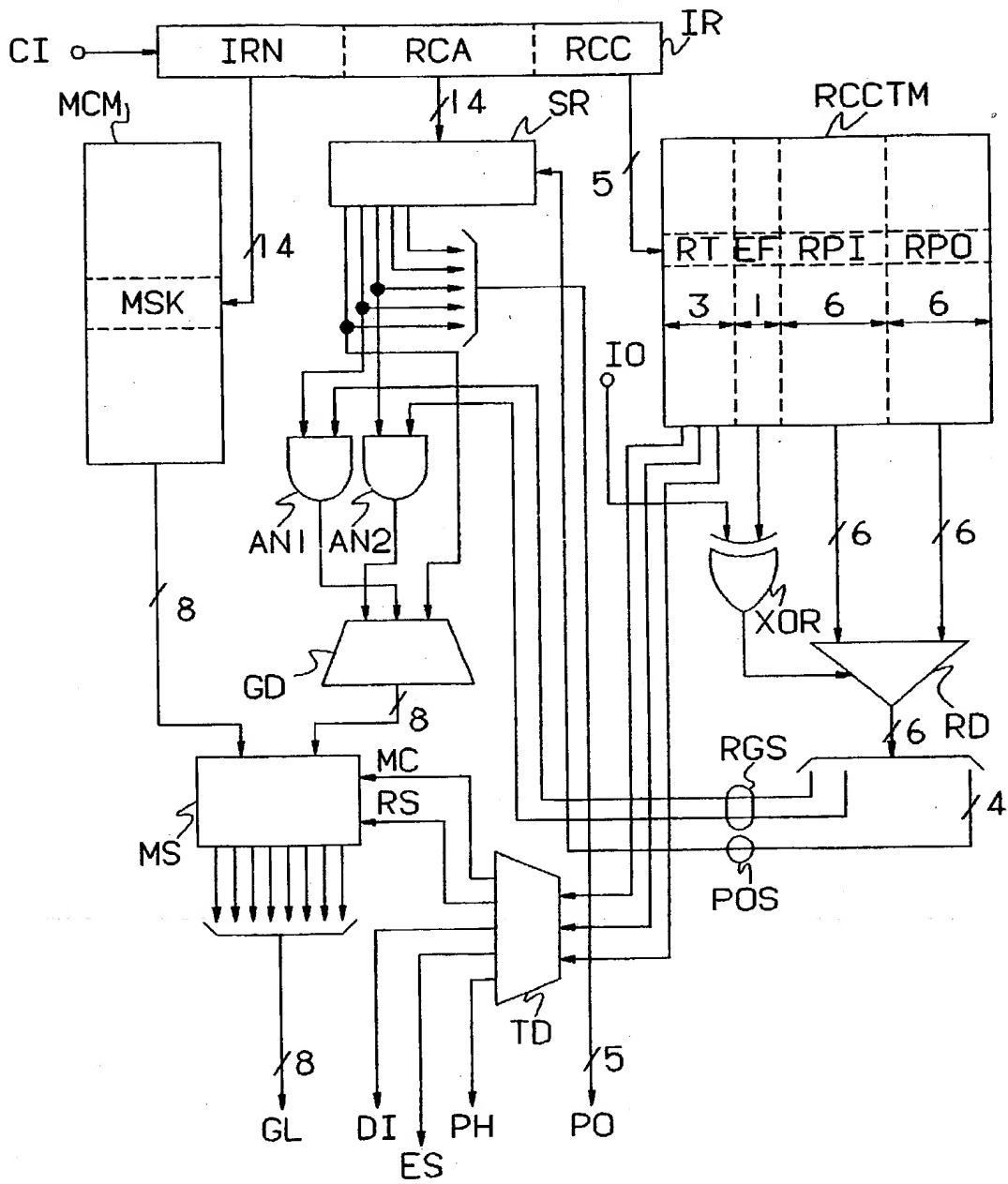


FIG.2



RL

FIG. 3



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number

EP 90 20 0594

| DOCUMENTS CONSIDERED TO BE RELEVANT | | | |
|---|---|---|---|
| Category | Citation of document with indication, where appropriate, of relevant passages | Relevant to claim | CLASSIFICATION OF THE APPLICATION (Int. Cl.5) |
| A | EP-A-260364 (WASHINGTON UNIVERSITY) * column 1, line 44 - column 2, line 31 * * column 3, line 40 - column 5, line 16 * * column 5, line 36 - column 6, line 54 * * column 9, line 8 - column 10, line 4 * * column 17, line 49 - column 18, line 45 * | 1-6, 13-17 23 29, 30 | H04L12/56 |
| A | WO-A-8603355 (AMERICAN TELEPHONE AND TELEGRAPH COMPANY) * page 3, line 7 - page 4, line 16 * * page 5, lines 9 - 30 * * page 6, lines 17 - 37 * | 1-8, 10, 13, 29, 30 | |
| A | IEEE Pacific Rim Conference on Communications, Computers and Signal Processing, June 1st- 2nd, 1989 Victoria, BC, Canada, pages 620-623, New York, US; G.B. Mund et al.: " A 2x2 Switching Element for Broadband ISDN " * page 620, right-hand column, line 33 to 46 ; page 621, left-hand column, lines 12-24, 44-49; page 621, right-hand column, lines 17-60* | 1-4, 8, 11, 25, 29, 30 | |
| | | | TECHNICAL FIELDS SEARCHED (Int. Cl.5) |
| | | | H04L |
| The present search report has been drawn up for all claims | | | |
| Place of search | Date of completion of the search | | Examiner |
| THE HAGUE | 21 NOVEMBER 1990 | | STAESSEN B. F. |
| CATEGORY OF CITED DOCUMENTS | | | |
| X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document | | F : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application I : document cited for other reasons & : member of the same patent family, corresponding document | |